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ABSTRACT

This study sought to determine whether mnemonics or lecture was a more effective teaching technique in the instruction of world geography facts within a pull-out gifted education program for eight elementary-level minority students from a Hispanic dominant school within a rural, Hispanic dominant district. Graphic results supported the hypothesis that mnemonics was more effective, but statistical analysis did not, as measured by students' scores on labeling world maps. The interaction between sessions and mnemonics did not significantly predict knowledge of world geography facts above and beyond the linear components of sessions or mnemonics. However, the students did retain more total world geography facts using mnemonics than lecture. The study also found that statistical analysis can be effectively conducted on a single-subject inquiry to provide results that are more powerful and generalizable than graphic results. (JDD)

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ED 379 820

Running head: INQUIRY IN GEOGRAPHY

A Statistical Analysis of A Single-Subject Inquiry in Geography

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Abstract

The purpose of this statistical analysis of a single-subject inquiry was to determine if the results of the inquiry, which were graphically significant, would also be statistically significant. The inquiry was conducted by a teacher as researcher to determine whether mnemonics or lecture was a more effective teaching technique in the instruction of world geography facts within a B-level (maximum two hours direct service), pull-out, gifted-minority program. Graphic results support the hypothesis that mnemonics are more effective in teaching world geography facts than are traditional lecture techniques. Results of the statistical analysis did not support the hypotheses that mnemonics was a more effective teaching technique than lecture, and that the interaction between sessions and mnemonics predicted knowledge of world geography facts. However, results of the statistical analysis did support the hypothesis that the students retained more total world geography facts using mnemonics than lecture throughout the entire study, regardless of phase. Given the significance of the third hypothesis, the researcher concluded that statistical analysis can be effectively conducted on a single-subject inquiry to provide results that are more powerful and generalizable.

World Geography Instruction for Gifted-Minority Students Using Mnemonics Versus Lecture: A Statistical Analysis of A Single-Subject Inquiry

This study was conducted within a B-level program designed to pull gifted-minority students out of their regular classes during science and social studies. This pull-out situation had resulted in a lack of science and social studies instruction for these students. Using an alternating treatment design (ATD), the researchers hypothesized that mnemonics, defined as a technique involving the transformation of otherwise difficult-to-remember material into something more memorable (Levin, 1993), would be a more effective teaching technique than traditional lecture in the instruction of world geography facts. Graphic results supported this hypothesis (Rowlison & Merta, 1993), but the primary researcher wanted to determine if a statistical analysis would produce the same results. The specific research hypotheses (RH) used for the statistical analysis were as follows:

RH1: For the population of gifted-minority students, the use of mnemonics (M) as a teaching technique will be more effective than lecture in the predication of knowledge of world geography facts (WGF) as measured by the students' scores on the unlabeled maps provided.

Full Model: $WGF = aU + bM + E1$

Want: $M > 0$

Restriction: $M = 0$

Restricted Model: $WGF = aU + E2$

RH2: For the population of gifted-minority students, the interaction between sessions (SES) and mnemonics will predict knowledge of WGF above and beyond the linear components of sessions and mnemonics.

Full Model: WGF = aU + bSES * M + cSES + dM + E3

Want: SES * M > 0

Restriction: SES * M = 0

Restricted Model: WGF = aU + cSES + dM + E4

RH3: For the population of gifted-minority students, the students will retain more total world geography facts (TOT) using mnemonics than lecture as measured by posttest mnemonics (POSM) and posttest lecture over and above individual differences (P1 - P7).

Full Model: TOT = aU + bPOSM + cP1 + dP2 + eP3 + fP4 + gP5 + hP6 + iP7 + E5

Want: POSM > 0

Restriction: POSM = 0

Restricted Model: TOT = aU + cP1 + dP2 + eP3 + fP4 + gP5 + hP6 + iP7 + E6

An ATD was chosen because of its ability to provide a more efficient comparison of the effectiveness of the selected teaching techniques, mnemonics and lecture (Stile, 1993). Due to a small population of gifted-minority students in the given rural area, a single-subject inquiry was necessitated. The design used *one class* of eight students as the target population (N=1). The ATD also allowed modification of the teaching techniques during the course of instruction, thus increasing the desired observable behavior (Stile).

One reason for selecting mnemonics and lecture as the teaching techniques in the instruction of world geography facts was that since this program serviced different grade level gifted-minority students, a textbook targeted at one grade level was

inappropriate. A second reason for selecting mnemonics and lecture was to support the hypothesis that mnemonics would be a more effective teaching technique than traditional lecture in the instruction of world geography facts. Blankenship (1989) reported a lack of geographical literacy in the United States. The use of mnemonic devices is one way of helping students to remember geography facts. Through mnemonics, students perform significantly better on both immediate and delayed chapter tests than with the use of traditional lecture (Mastropieri & Scruggs, 1989). The purpose of this study was to determine whether statistical analysis would support the graphic results that mnemonics is a more effective teaching technique than lecture in the instruction of world geography facts.

Method

Subjects

Eight subjects were chosen and treated as a single group from a B-level, pull-out, gifted-minority program in a rural, Hispanic dominant school within a rural, Hispanic dominant district. P1 was a Hispanic female in fifth grade, P2 was an Caucasian male in the fifth grade, P3 was an Caucasian male in fifth grade, P4 was a Hispanic female in fifth grade, P5 was a Hispanic male in fourth grade, P6 was a Hispanic female in fourth grade, P7 was a Hispanic female in third grade, and P8 was a Hispanic male in second grade.

Material

An unlabeled world map (see Appendix A) was provided to the students as a pretest before instruction. This map (derived from a map by Rand McNally, 1985) was flat and outlined political boundaries. Students were asked to label as many (a) topographical areas; (b) countries; and (c) continents, oceans, and seas as they could.

A new copy of the same map was given to the students each session with the same instructions. Only the newly presented material (three geography facts per category) was graded on a session by session basis. Cumulative learning was assessed through posttest observations to determine overall gain of geography facts as well as the gains using mnemonics and the gains using lecture.

Procedure

The geography facts were selected from three categories: (a) topography; (b) countries; and (c) continents, oceans, and seas. A total of 24 facts were instructed in each category. Although the ATD used did not require a baseline, a pretest was given to determine the gifted-minority students prior knowledge of world geography facts. A posttest was given after the mnemonics phase to determine the gain in world geography facts using mnemonics. This was done by only scoring the correct labels for geography facts that were presented during the mnemonics phase. Another posttest was given after the lecture phase to determine the gain in world geography facts using lecture. This was done by scoring only correct labels for geography facts presented during the lecture phase. A final posttest was given to determine overall gain of knowledge of world geography facts from previous knowledge of world geography facts as determined by pretest.

During phase one, mnemonics was used as the teaching technique. The categories were randomly counterbalanced for each session to determine the order in which the instruction would be provided. Instruction for each category was not to exceed 20 minutes. Instructors were also counterbalanced. A co-researcher provided instruction during sessions two and four of phase one. The co-researcher also scored the map quizzes for these sessions. Phase one consisted of four sessions at which time

it was determined through visual examination of graphic representation of percent correct that use of mnemonics had established a trend. Therefore, phase two was initiated using lecture as the teaching technique.

During phase two, categories were again randomly counterbalanced and instruction for each category was not to exceed 20 minutes. Instruction was counterbalanced during sessions five and seven. Phase two consisted of four sessions at which time it was determined through visual examination of graphic representation of percent correct that use of lecture had established a trend.

Results

Graphic Analysis

Graphic representation shows that mnemonics as a teaching technique is more effective than lecture based on comparison of means of percent correct in phases in which each was used. Pretest and posttest data show that there was an overall gain of world geography facts for the gifted-minority students (Rowlison & Merta, 1993).

Insert Figures I - VI about here

Statistical Analysis

Results of the statistical analysis did not support research hypothesis one. For the population of gifted-minority students, the use of mnemonics as a teaching technique was not significantly more effective than lecture in prediction of knowledge of world geography facts as measured by the students' score on the unlabeled maps provided at an alpha of .05.

Insert Table I about here

Results of the statistical analysis did not support research hypothesis two. For the population of gifted-minority students, the interaction between sessions and mnemonics did not significantly predict knowledge of world geography facts above and beyond the linear components of sessions or mnemonics at an alpha of .05.

Insert Table II about here

Results of the statistical analysis did support research hypothesis three. For the population of gifted-minority student, the students did significantly retain more total world geography facts using mnemonics than lecture as measured by posttest mnemonics and posttest lecture over and above individual differences at an alpha of .05.

Insert Table III about here

Discussion

As hypothesized, mnemonics as a teaching technique for instruction in world geography facts is more effective than lecture based on the graphic representation of the means of the percent correct in the phase in which each was used. Graphic representation of posttest data also supported the hypothesis. However, results of the statistical analysis did not support the hypothesis that mnemonics was a more effective

teaching technique than lecture, or that the interaction between sessions and mnemonics would predict knowledge of world geography facts. Results of the statistical analysis did support the hypotheses that students would retain more total world geography facts using mnemonics than lecture. Time restraints prohibited a third phase using mnemonics to strengthen support for this hypothesis. More research should be conducted in this area and should include a third phase using mnemonics. Alternating back to another mnemonics phase would also provide stronger support for the hypothesis if significance was found.

It should be noted that the researchers felt that information on world geography facts provided in the earlier part of the inquiry was more familiar to students. The first phase included the seven continents and the five largest oceans. Most of the students had been exposed to this information prior to the study even if they did not correctly label these items on the pretest map. As the study progressed, the information provided became more unfamiliar to the students. Further research should adjust for this design problem.

In addition, during the lecture phase the students seemed to miss using the mnemonics and had a hard time understanding why mnemonics were no longer being used. This might have contributed to their loss of interest in later sessions. Replication of this research might consider inquiry where the lecture phase is presented before the mnemonics phase.

Finally, the fluctuation found between data points within each phase makes it difficult to interpret the results using only graphic representations of the data. This fluctuation may account for the lack of significance found when conducting the statistical analysis on the hypotheses that mnemonics would be a more effective

teaching technique than lecture, and that interaction between sessions and mnemonics would predict knowledge of world geography facts. The pretest and posttest data, which included pretest, posttest mnemonics, posttest lecture, and a total posttest, did not fluctuate as much as other data. This reduction in fluctuation may have contributed to significance found when conducting statistical analysis on the hypothesis that students would retain more total world geography facts using mnemonics than lecture.

This study was advantageous to both teacher and students, allowing the teacher to collect the data and disseminate information about effective teaching techniques, and encouraging the students to learn world geography facts. The research project did require more preparation and organization than what would typically be expected from a teacher not conducting research in the classroom. Results of the research project indicate that statistical analysis can be effectively conducted on a single-subject inquiry to provide results that are more powerful and generalizable.

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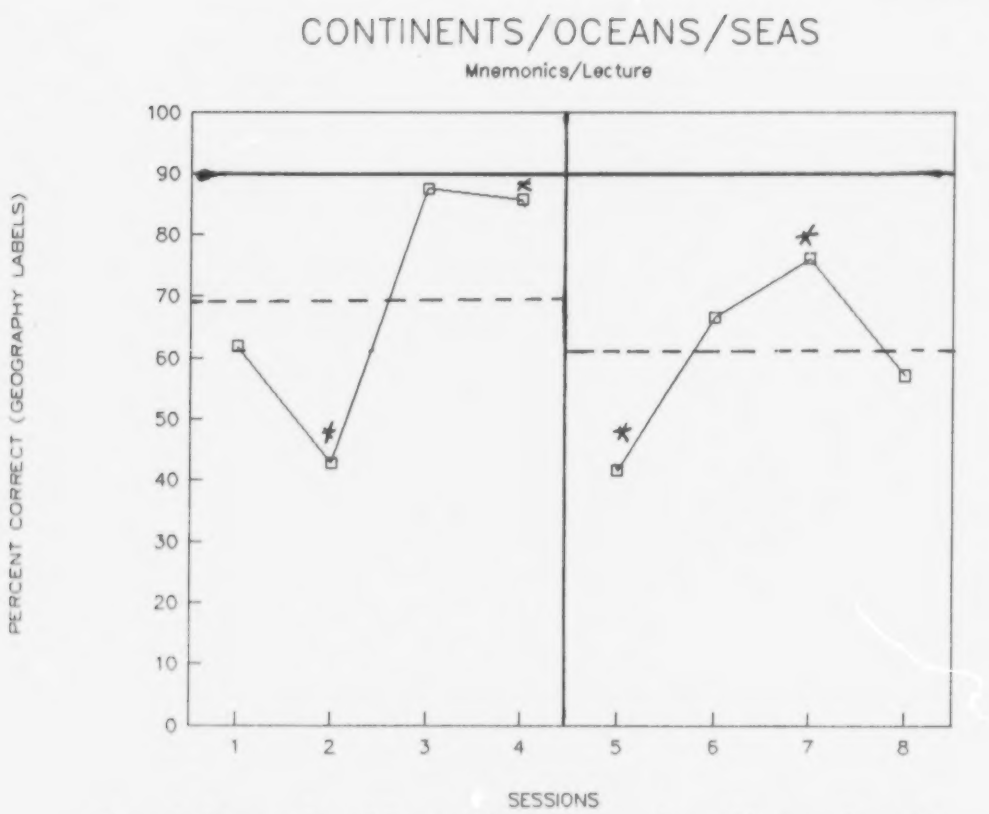

Figure 1. Means of trend lines within the mnemonics and lecture phases for continents/oceans/seas.

Trend lines

----- Means

* Reliability Checks

____ Target criteria

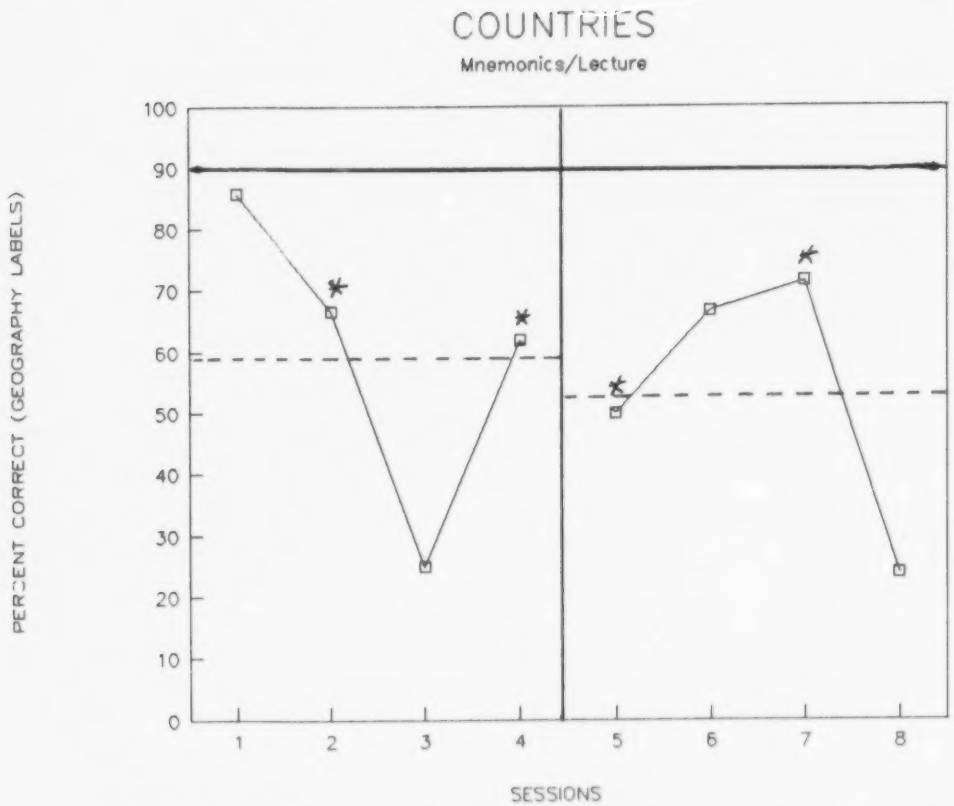

Figure II. Means of trend lines within the mnemonics and lecture phases for countries.

Trend lines

----- Means

* Reliability checks

____ Target criteria

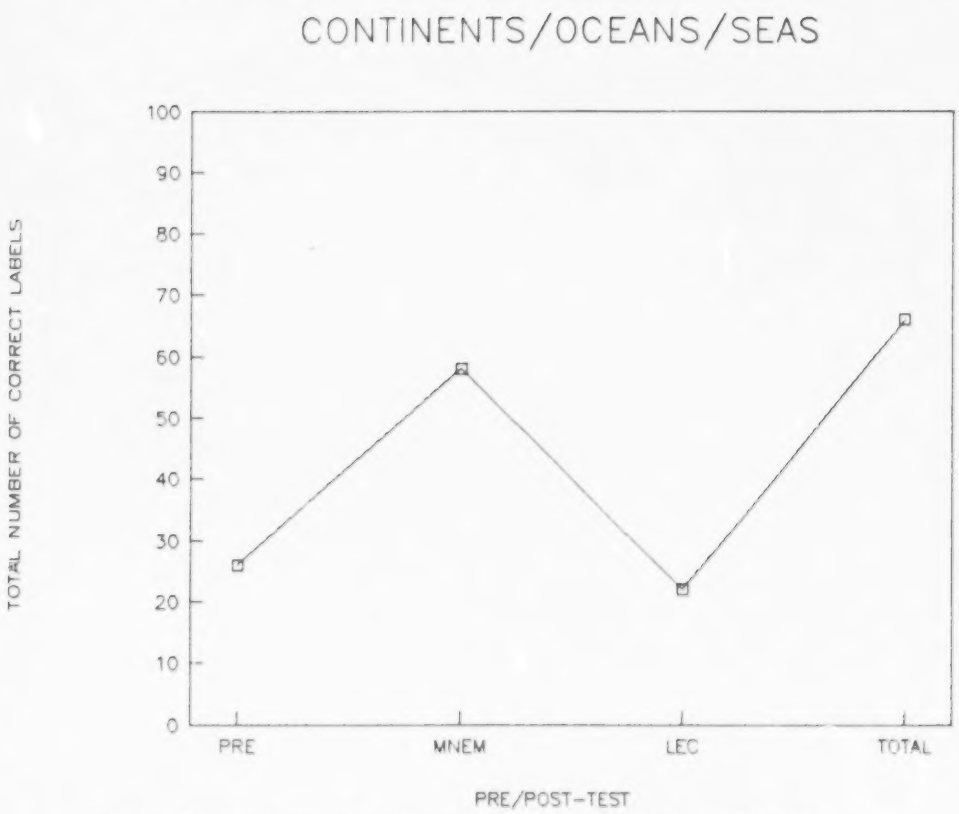

Figure IV. Pretest and posttest data for continents/oceans/seas.

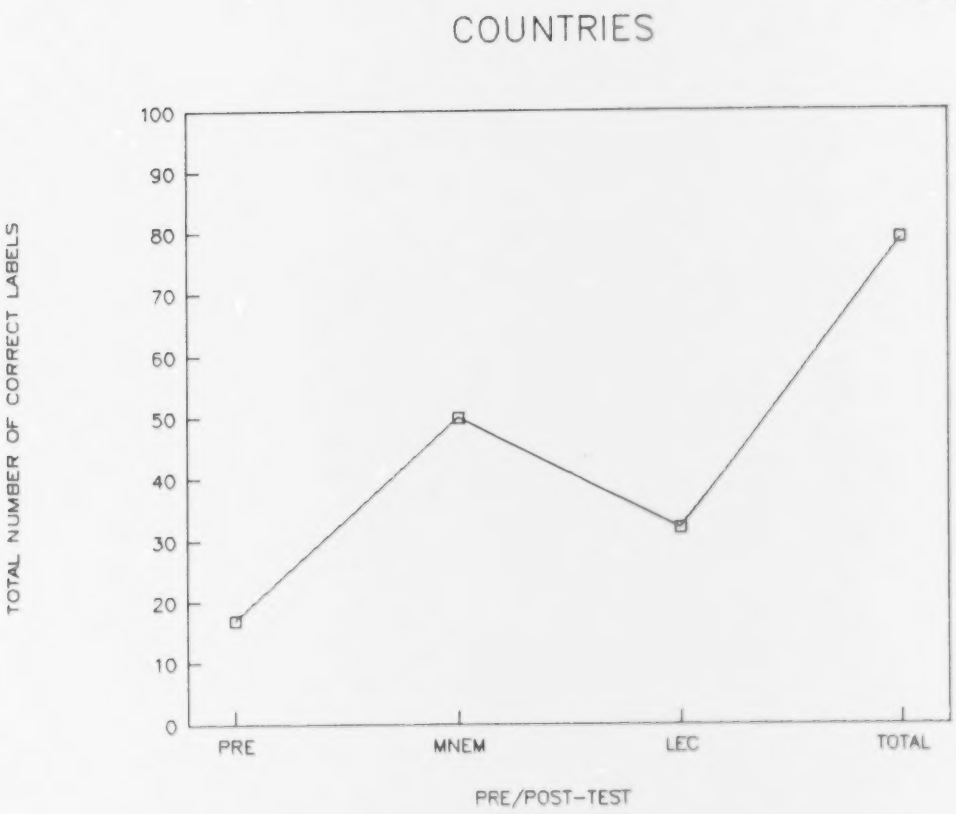

Figure V. Pretest and posttest data for countries.

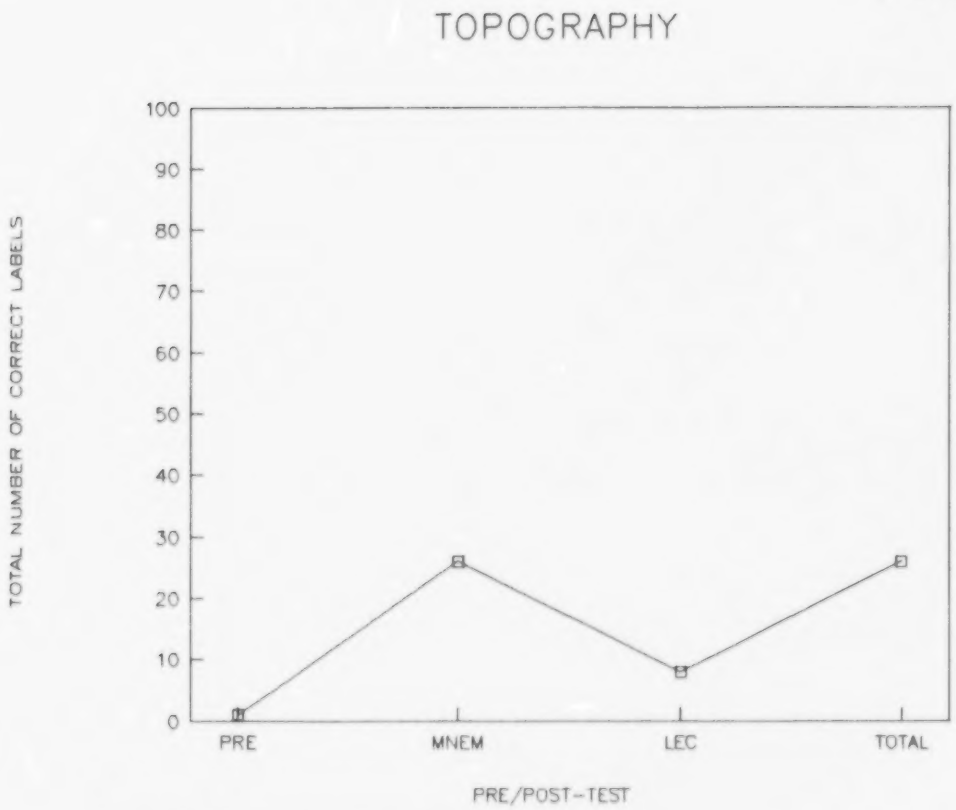

Figure VI. Pretest and posttest data for topography.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	308.16667	308.16667	0.559	0.4624
Error	22	12117.79333	550.80879		
C Total	23	12425.96000			

Root MSE	23.46932	R-square	0.0248
Dep Mean	50.25000	Adj R-sq	-0.0195
C.V.	46.70511		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	46.666667	6.77500792	6.888	0.0001
M	1	7.166667	9.58130809	0.748	0.4624

Table 1. Results from statistical analysis for hypothesis one.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	3	389.59733	129.86578	0.216	0.8843
Error	20	12036.36267	601.81813		
C Total	23	12425.96000			

Root MSE	24.53198	R-square	0.0314
Dep Mean	50.25000	Adj R-sq	-0.1139
C.V.	48.81986		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	42.983333	41.77645972	1.029	0.3158
SESM	1	-2.826667	8.95781323	-0.316	0.7556
SES	1	0.566667	6.33413048	0.089	0.9296
M	1	16.500000	45.23473945	0.365	0.7191

Table II. Results of statistical analysis for hypothesis two.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	8	712.94450	89.11806	6.203	0.0001
Error	39	560.30550	14.36681		
C Total	47	1273.25000			

Root MSE	3.79036	R-square	0.5599
Dep Mean	7.12500	Adj R-sq	0.4697
C.V.	53.19800		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	3.399269	1.64327204	2.069	0.0453
POSM	1	0.610757	0.17465044	3.497	0.0012
P1	1	2.880278	2.21166433	1.302	0.2004
P2	1	4.010026	2.22083981	1.806	0.0787
P3	1	5.694621	2.19010538	2.600	0.0131
P4	1	-5.944091	2.19532199	-2.708	0.0100
P5	1	-0.063812	2.24361436	-0.028	0.9775
P6	1	1.027955	2.19010538	0.469	0.6414
P7	1	2.249469	2.20398891	1.021	0.3137

Table III. Results of statistical analysis for hypothesis three.

Appendix A